Price Variation and the Role of Market Power in School Food Procurement

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Abstract

K-12 public schools serve more than seven billion meals annually, making school food procurement one of the largest service-delivery expenditures of local governments. Yet remarkably little is known about how efficiently school districts purchase food from private suppliers. Using a new item-level database covering more than 100 California school districts and more than $1 billion in procurement spending, we document substantial price dispersion for identical manufacturer-specified products across otherwise similar districts. We show that these differences cannot be explained by transportation costs or product characteristics and instead reflect systematic differences in procurement practices, distributor choice, and contract design. We then develop two complementary empirical strategies to quantify the role of distributor market power. First, exploiting competitive procurement auctions, we recover equilibrium markups from the first-order conditions of first-price procurement auctions and estimate average markups of 17% over procurement costs. Second, exploiting contract rollover pricing in multi-year agreements, we show that contract prices exhibit asymmetric cost pass-through ("rockets and feathers"): prices rise rapidly when costs increase but adjust little when costs fall, causing distributor markups to increase over the life of the contract. Together, these findings identify distributor market power as a potentially important driver of procurement prices and public food procurement costs, suggesting that improvements in procurement design could generate meaningful cost savings for school districts.

1 Introduction

State and local governments increasingly deliver public services through procurement rather than direct production. Public schools purchase food from private suppliers, transportation agencies contract with private construction firms, and Medicaid programs rely on private insurers and healthcare providers. As governments face mounting budget pressures, understanding whether these goods and services are purchased efficiently has become an increasingly important policy question. Yet despite the scale of public procurement, remarkably little is known about why otherwise similar government agencies often pay substantially different prices for identical products or whether these differences reflect unavoidable costs or opportunities for more efficient purchasing.

School food procurement provides an ideal setting to study these questions. In 2024, K-12 public schools served more than seven billion meals to nearly 30 million children, providing one-third to one-half of daily calories for many low-income students and contributing to both health and educational outcomes [USDA Food and Nutrition Service,

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2024, Spill et al., 2024, Anderson et al., 2018]. Delivering these meals requires school districts to purchase billions of dollars of food from private manufacturers and distributors through competitive procurement processes. California school districts alone spend nearly $3 billion annually on food purchases, while federal expenditures exceed $23 billion per year [Fox and Gearan, 2019, Newman et al., 2008]. At the same time, school nutrition authorities face increasing financial pressure: 95 percent report persistent supply-chain disruptions and 85 percent identify rising food costs as a major operational challenge [USDA Food and Nutrition Service, 2025]. These pressures intensified as food prices increased by approximately 24 percent between 2020 and 2023 [U.S. Department of Agriculture, Economic Research Service, 2025].

Despite the importance of these expenditures, systematic evidence on procurement prices is surprisingly scarce. The USDA last collected nationwide procurement-price data in 2009–2010 [USDA Food and Nutrition Service, 2012], and the existing literature consists primarily of individual district case studies or evaluations of specific procurement initiatives [Long et al., 2021, Krasnoff et al., 2023, Watson et al., 2018]. Consequently, policymakers know remarkably little about how much districts actually pay for identical products or why procurement costs differ so substantially across otherwise similar school systems.

This paper addresses this gap by assembling a new item-level database of school food procurement contracts, bids, invoices, and quantities collected through public-records requests. The database currently covers more than 100 California school districts and more than $1 billion in procurement spending. By matching products using manufacturer item numbers, we compare prices paid for exactly the same manufacturer-specified products while abstracting from differences in quality, package size, and product formulation. We document substantial price dispersion. Within the same metropolitan area, districts routinely pay 20–30 percent different prices for identical products, with much larger differences for some items.

The central question is what explains these differences. Some variation may reflect transportation costs, economies of scale, or differences in local procurement environments. Another possibility is the increasing concentration of food distribution markets. Recent consolidation among food distributors has substantially reduced supplier choice [MacDonald et al., 2023, U.S. Federal Trade Commission, 2015, US Foods Holding Corp., 2018, Performance Food Group Company, 2019, Highview Capital, LLC, 2019]. Concerns about competition in school food procurement are not new: collusive bidding in school milk procurement remains one of the canonical empirical studies of cartel behavior in industrial organization [Porter and Zona, 1999]. If concentration allows distributors to earn persistent rents, then procurement design may become an important determinant of government spending.

To quantify the role of supplier market power, we develop two complementary empirical approaches. First, we exploit formal procurement auctions to recover equilibrium markups from observed bids using the first-order conditions of first-price procurement auctions. We estimate an average markup of 17% of bids over marginal costs across items and bidders. The markup applies to total procurement costs, including the manufacturer's price and not just distribution services. Our estimates suggest that increasing auction participation from two to three symmetric bidders could reduce the markup (and hence prices) by 8.5 percentage points on average, resulting in substantial cost savings to schools. Second, we study data from multi-year contracts and document asymmetric pass-through of input-cost shocks during contract renewals—a "rockets and feathers". We document that prices rise rapidly when costs increase but ad- just little when costs fall, causing distributor markups to increase over the life of the contract. This asymmetry raises markups by several percentage points for products experiencing below-average cost growth at each renewal, with effects that compound over longer contract horizons.

Together, these findings identify distributor market power as a potentially important driver of procurement prices and public food procurement costs. They also suggest that improvements in procurement design could generate meaningful cost savings for school districts.

This paper makes three contributions. First, it provides the first large-scale evidence on the efficiency of school food procurement using a new item-level database covering a substantial share of California school districts. Second, it introduces complementary methods for measuring supplier markups using both competitive procurement auctions and contract renewals. Third, it identifies procurement practices—including distributor choice, direct purchasing from manufacturers where feasible, and contract design—that have the potential to reduce the cost of delivering an important public service without reducing nutrition standards or service quality.

2 Institutional Setting and Data

We assemble a new database of K-12 school food procurement contracts, bids, invoices, and quantities from public-records requests. The database covers school food authorities (SFAs) that procure either independently or through purchasing cooperatives, excluding the approximately 25% of districts that outsource procurement to food-service management companies [Williams et al., 2021]. Purchasing cooperatives negotiate contracts on behalf of multiple school districts, ranging in our data from a handful to as many as 30 districts. Throughout the paper, we treat each cooperative as a single purchasing entity, or school food authority (SFA). The database currently spans more than 100 procuring districts across the San Francisco, Los Angeles, San Diego, and Sacramento Metropolitan Statistical Areas (MSAs), representing more than $1 billion in tracked procurement spending between the 2023–24 school year and the present. We expect to expand coverage to several additional California districts by the end of 2026.

Our analysis focuses on commercially distributed branded food products—including bread, frozen foods, produce, dry groceries, and prepared entrees—that are purchased through large regional distributors or manufacturers. These products account for a large share of procurement spending and can be matched precisely across buyers using manufacturer item numbers. We currently exclude products procured from local vendors, for which identical-product comparisons are less reliable. These include dairy contracts, whose prices are typically indexed and updated weekly, as well as bread from local bakeries, locally sourced produce, and certain prepared pizza products, for which standardized manufacturer identifiers are often unavailable. We plan to incorporate these categories in future versions of the database.

The underlying records consist of heterogeneous, unstructured documents—including scanned bid tabulations, RFPs, contract awards, and invoice line items—which we digitize and harmonize into a common database. We normalize products using manufacturer item numbers and organize them hierarchically into item categories, subcategories, and broader food groups.[1] We are further expanding the database by incorporating USDA entitlement and value pass-through records, Local Food for Schools data, ingredient and nutrition information, and kitchen infrastructure surveys.

The ability to match identical products (with identical pack sizes) across buyers is central to our analysis. A key challenge in measuring price dispersion is distinguishing differences in market power from differences in product characteristics such as package size, formulation, or service quality. Manufacturer item numbers allow us to compare prices

[1] We study commercial prices and focus on single-drop prices whenever possible.

paid for the exact same product across purchasing authorities and over time. The remaining variation therefore reflects differences in procurement conditions rather than product heterogeneity, providing the foundation for our analysis of market power.

3 Descriptive Facts

3.1 Price Dispersion Across School Districts

Figures 1a and 1b provide first evidence on price dispersion across school districts in the Los Angeles and San Francisco MSAs for the school year 2025/2026. We restrict the comparison to districts within the same MSA because they face similar transportation costs and often purchase from the same distributors, making them natural benchmarks for one another.

The analysis compares prices for identical products matched using manufacturer item numbers whenever available and, otherwise, high-quality text matching based on product descriptions, brands, and package characteristics. For each matched product i, we measure price dispersion as the percentage difference between the highest and lowest observed contract price in the corresponding MSA,

$$\frac{\max_{s \in MSA}(p_{is}) - \min_{s \in MSA}(p_{is})}{\min_{s \in MSA}(p_{is})} \times 100. \tag{1}$$

Here, p_{is} denotes the price per case that SFA s located in the respective MSA pays for product i.

Products are grouped into food groups and subgroups, and each box plot summarizes the distribution of product-level price differences within a category. The mean and the median therefore represent the typical percentage price gap between the highest- and lowest-paying districts for the same product in a given product category.

The evidence reveals substantial price dispersion. In the Los Angeles MSA, identical products differ in price by about 20% on average between the lowest- and highest-paying districts, ranging from 10% for beverages to 28% for fats, condiments, and sweets. Dispersion is even greater in the San Francisco MSA, where the average price difference is about 30%. Although the magnitude varies across food groups, all exhibit substantial price dispersion.

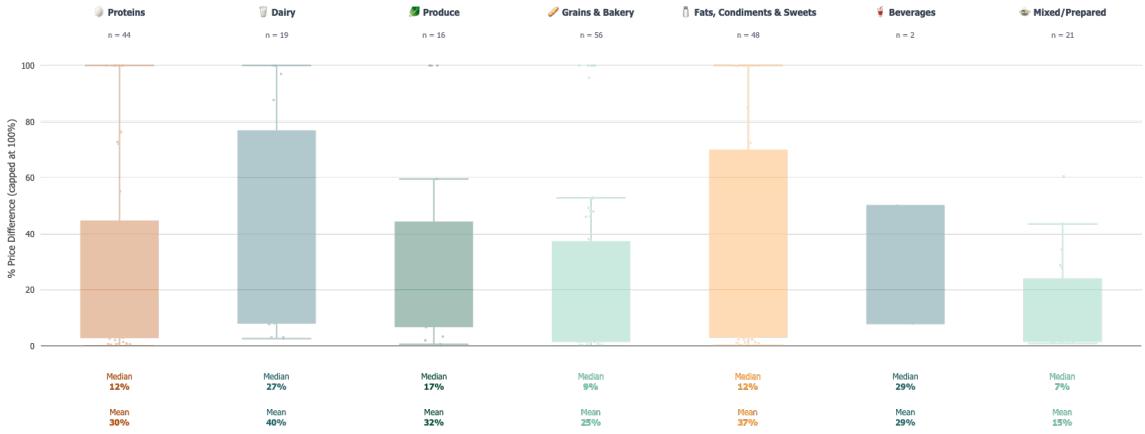
3.2 Case study: distance cannot explain the gaps

A common explanation for procurement price differences, and one that frequently arises in conversations with school food procurement managers, is transportation cost. While longer shipping distances and a greater number of delivery stops increase distribution costs, they are unlikely to fully explain the magnitude of the price differences documented above. First, whenever possible, we compare single-drop prices, thereby holding delivery complexity constant. Second, we observe substantial price differences that run counter to what transportation costs would predict. We illustrate this point using Yang's Mandarin Orange Chicken, one of the most widely purchased poultry products in California school meal programs.

Across 13 SFAs in three metropolitan areas, the identical product ranges from \$147.01 (district in San Diego) to \$196.67 (district in Los Angeles), a difference of \$49.66, or 33.8%. Importantly, the product is manufactured in South El Monte, California, within Los Angeles County. If transportation costs were the primary determinant of procurement prices, districts in the Los Angeles area (approximately 15 miles from the factory) should pay the



(a) Price Variation Between Districts in Los Angeles–Long Beach–Anaheim MSA



(b) Price Variation Between Districts in San Francisco-Oakland-Fremont MSA

Notes: This figure summarizes price differences for identical products (with identical pack sizes) between districts in the Los Angeles–Long Beach–Anaheim metropolitan statistical area (Figure 1a) and the San Francisco-Oakland-Fremont metropolitan statistical area (Figure 1b) in school year 2025/2026. Each observation (n) corresponds to the price range in percent for a single food item i, defined as $\frac{\max_{s \in MSA}(p_{is}) - \min_{s \in MSA}(p_{is})}{\min_{s \in MSA}(p_{is})} \times 100$, see also Equation (1). The box plots show the distribution of item-level price ranges within each food category.

lowest prices, followed by San Diego (approximately 120 miles) and then the San Francisco Bay Area (approximately 380 miles).

Table 1 shows a different pattern. The market closest to the production facility pays the highest average price, $185.69 per case on average, while districts located substantially farther away pay considerably less. The average price paid by districts located in the San Francisco MSA equals $169.43 per case, whereas districts located in the San Diego MSA pay only $151.61 per case on average. This suggests that transportation costs alone cannot account for the observed dispersion. Instead, the evidence points to differences in procurement practices, contracting, and buyer bargaining power as important determinants of prices.

3.3 Case study: Vendor options and the Distributor Markup

Building on this evidence, we next examine whether differences in distributor options can explain the observed price differences across school districts. We illustrate this using Don Lee Farms 100% Beef Steak Burgers, another popular food item.

Table 1: Average MSA Level Prices by Distance to Manufacturer

MSA	Approx. distance to factory	Average price
Los Angeles	∼15 mi	$185.69
San Francisco	∼380 mi	$169.43
San Diego	∼120 mi	$151.61

Notes: This table displays the average price per case for Yang's Mandarin Chicken among school districts in a given MSA. Prices reflect prices per case with identical pack sizes. Price data are for the school year 2025/2026. The second column displays the average distance between the MSA and the factory location, located in South El Monte (Los Angeles–Long Beach–Anaheim MSA).

Figure 2 compares contract prices for the beef steak burger across nine SFAs. Prices range from $232.36 to $291.04 per case, a difference of 25.3%. More strikingly, the variation is almost entirely explained by the distributor. Districts purchasing through distributors other than the dominant vendor pay only $235.38 per case on average, whereas districts purchasing through the main vendor pay $272.12 per cases on average, implying a distributor premium of $36.74, or 15.6%.

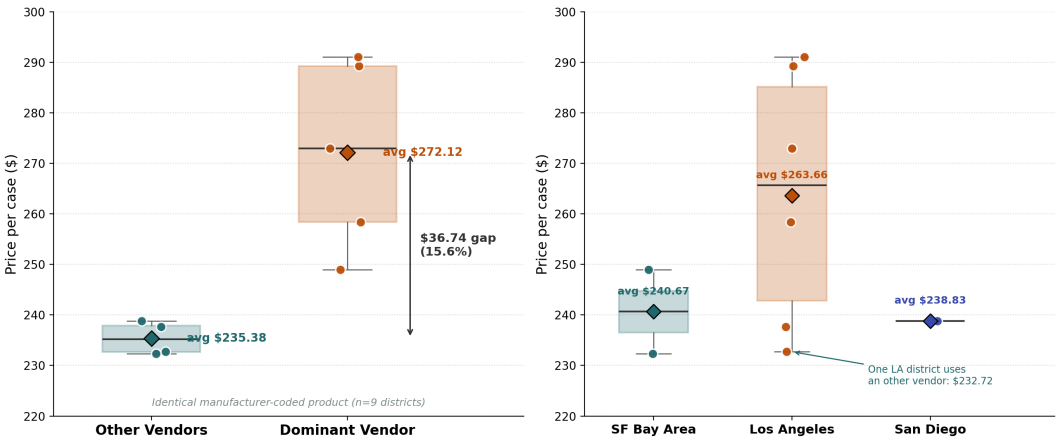


Figure 2: Price Differences by Vendor for Don Lee Farms' 100% Beef Steak Burger

Notes: The figure summarizes prices differences by vendor (left figure) and MSA (right figure) for Don Lee Farms' 100% Beef Steak Burger. Prices reflect prices per case with identical pack sizes. The data come from 9 school food authorities (SFAs) purchasing the item in school year 2025/2026. The SFAs are located in the Los Angeles–Long Beach–Anaheim MSA, the San Francisco-Oakland-Fremont MSA, and the San Diego-Carlsbad MSA.

The right panel shows that these differences are not driven by geography. Districts within the Los Angeles MSA pay substantially different prices depending on the distributor. Those purchasing through the dominant vendor in our sample pay up to nearly $60 more per case than districts using other distributors. Notably, the lowest prices are not paid by the largest purchasing cooperatives, suggesting that SFA scale alone does not guarantee lower procurement prices.

These patterns suggest that distributor choice is an important determinant of procurement prices. While distributor selection is itself endogenous, the evidence indicates that a substantial share of the observed price dispersion reflects differences in distributor markups and negotiated contract terms rather than transportation costs or product characteristics.

3.4 Case study: Cutting out the Middleman

Given that distributor choice shapes procurement prices, we also examine how costs change when sourcing directly from the manufacturer. We investigate this mechanism using a prominent procurement item, Tyson's Popcorn Chicken.

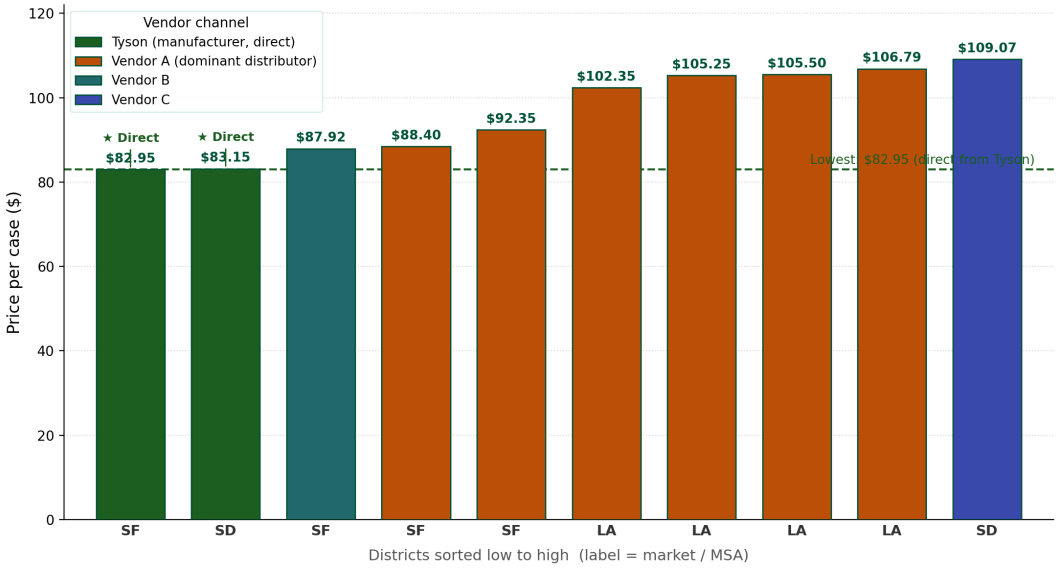


Figure 3: Price Differences by Vendor Channel for Tyson's Popcorn Chicken

Notes: The figure summarizes prices differences for Tyson's Popcorn Chicken in ascending order. Prices reflect prices per case with identical pack sizes. The data come from 10 school food authorities (SFAs) purchasing the item in school year 2025/2026. The coloring denotes the vendor channel: the two leftmost SFAs procure the item directly from the manufacturer (Tyson). The MSA associated with each SFA is shown below the bars.

As illustrated in Figure 3, sourcing directly from the manufacturer can substantially reduce procurement costs when it is operationally feasible. For this product, prices range from $82.95 to $109.07 across 10 SFAs—a 31.5% spread. The two SFAs purchasing directly from the manufacturer pay virtually identical prices despite being located hundreds of miles apart, suggesting that the manufacturer's price is relatively uniform across the state. In contrast, every district purchasing through a distributor pays substantially more for the identical product. While direct purchasing is not feasible for every district, because it often requires sufficient storage capacity and logistics infrastructure, the comparison highlights the potentially large savings from bypassing intermediaries when those capabilities exist.

What the case studies share

Taken together, the three case studies point to a common conclusion. Large price differences for identical manufacturer-coded products cannot be explained solely by transportation costs or product heterogeneity. Instead, prices appear to depend systematically on the procurement environment, including distributor choice and the distribution channel. Although these patterns are consistent with substantial variation in distributor markups, they do not constitute direct evidence of market power.[2] The remainder of the paper therefore develops two complementary empirical strategies to directly quantify distributor markups

[2]For example, although we focus on single-drop prices whenever possible, some districts do not report the number of delivery sites, which may contribute to price differences. Likewise, distributor choice may be correlated with procurement volume, which could also affect prices.

and assess the role of market power in generating the observed price dispersion. The first exploits evidence from formal procurement auctions to recover markups at the time contracts are awarded. The second uses within-contract renewal data to measure the evolution of rents after procurement, when competitive pressure has disappeared.

4 Markups in Procurement Auctions

To quantify the extent of market power and the economic magnitude of markups, we turn to data from formal procurement auctions. Under California law, school districts must procure food through formal competitive bidding processes (RFPs or IFBs) for contracts exceeding $100,000. Some districts use scoring auctions that evaluate both price and non-price attributes, while others award contracts solely to the lowest bidder through first-price procurement auctions. We begin by focusing on the latter. We apply techniques from the empirical auction literature to recover unobserved marginal costs and markups from observed bids.

Model. We start by considering a first-price procurement auction with $N \geq 2$ symmetric bidders and independent private costs. A firm with cost c that bids b wins only if it underbids all $N-1$ rivals; with rival bids drawn from G this happens with probability $(1-G(b))^{N-1}$, so expected profit is $\Pi = (b-c)\,(1-G(b))^{N-1}$. As shown by Guerre et al. [2000], the equilibrium first-order condition can be written as:

$$\frac{b-c}{b} = \frac{1-G(b)}{(N-1)\,b\,g(b)} = \frac{1}{\eta(b)}. \tag{2}$$

where $\eta(b)$ denotes the elasticity of the probability of winning with respect to the bid.

Equation (2) provides the key identification result. If the bid distribution G and density g can be recovered from observed bids, then equilibrium markups $\frac{b-c}{b}$ and, in turn, unobserved marginal costs c can be inferred. Intuitively, firms shade bids above costs in inverse proportion to how sensitive their probability of winning is to a price increase. Where winning probabilities are relatively inelastic—for example because there are few competitors or firms are highly differentiated in costs—markups are large. Greater competition increases the elasticity of winning and compresses markups. Throughout the empirical application we study the most competition-scarce case, N=2, implying that the recovered markups represent an upper bound on those that would arise in thicker markets. We note however, that we also see many auctions with only one effective bidder. In these auction the markup could be larger.

4.1 Preliminary evidence

We illustrate the approach using bids from a single school district procurement in which two vendors (denoted as A and B) submitted independent per-item bids and the contract for each item was awarded to the lowest bidder. We focus on the 58 contested items for which both vendors submitted bids, treating each item as an independent two-bidder first-price auction. We exclude the remaining 160 item auctions, which received only one effective bid. If anything, we expect the markups to be lower in the contested auctions, providing a conservative lower bound.

Auction-level heterogeneity. A central empirical challenge is that procurement auctions involve highly heterogeneous products sold at vastly different prices. Equation (2) applies conditional on auction-specific cost conditions, so this heterogeneity must be accounted

for before recovering markups. Following Krasnokutskaya [2011], we model auction-level heterogeneity as a multiplicative cost shifter,

$$c_i = e^{\gamma x}\, e^{w_i}. \tag{3}$$

where x is an auction-specific cost component common to all bidders and w_i is bidder i's private cost shock. Because the equilibrium bidding function is homogeneous of degree one in costs, the common factor passes through proportionally into bids,

$$b_i = e^{\gamma x}\, \beta(w_i), \qquad \log b_i = \gamma x + \log \beta(w_i). \tag{4}$$

Figure 4 illustrates the importance of auction heterogeneity across the 58 contested auctions. Even after controlling for package size (pounds), log bids exhibit a standard deviation of 0.89 log points. For example, flour is procured for roughly \$0.40 per pound, whereas bacon sells for more than \$14 per pound. Grouping products into text-based clusters reduces the standard deviation to 0.48 log points, but substantial variation remains. By contrast, within-auction log bid differences have a standard deviation of only 0.28 log points. Under the multiplicative model, the log difference eliminates the common auction-level cost component exactly and isolates variation in bidders' private costs.

Direct estimation of equation (2) relies on the correctly specified bid distribution, after purging off the bids from auction-level heterogeneity. Remaining auction-level heterogeneity inflates the dispersion of observed bids, which the model then incorrectly attributes to private cost heterogeneity. This leads to downward-biased estimates of competitive pressure and upward-biased estimates of markups. While we could add further controls to purge off additional auction heterogeneity, the relatively large dispersion in the bid distribution in Figure 4 raises the concern that some unobserved auction heterogeneity may still persist.

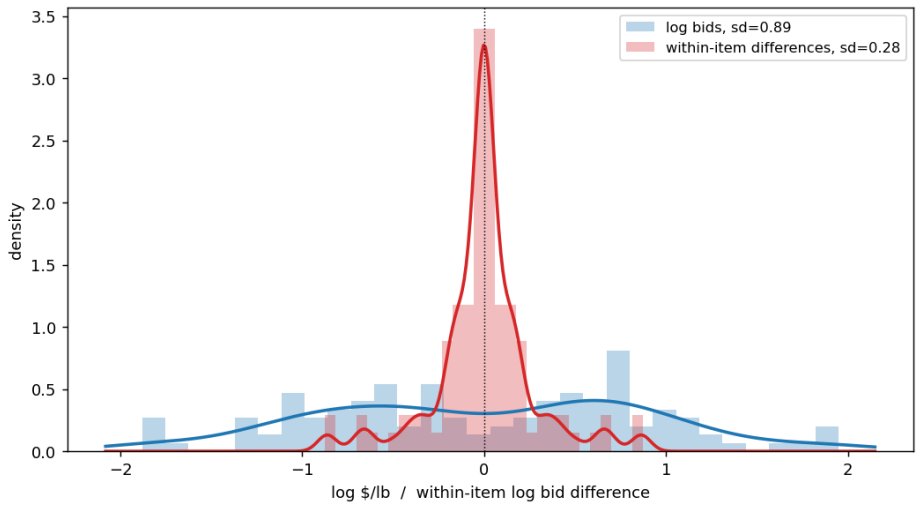


Figure 4: Within vs. Between-Auction Variation in Bids

Notes: This figure summarizes differences in submitted bids between items in blue (wider spread) and between bidders for the same item in red (narrower spread). The data comprise 58 contested item-specific auctions from one school food authority. The horizontal axis denotes log prices per case. Log prices between auctions (red) are net off differences in pounds per case. The blue graph displays the density of residualized bids. The red graph plots the density of within-item differences in log prices between bidders.

Estimator based on within-auction bid differences While the literature has proposed methods to address unobserved auction heterogeneity Asker [2010], Krasnokutskaya [2011]

we propose an alternative approach that appears less sensitive to remaining unobserved auction heterogeneity in our setting and in complementary simulation exercises. Specifically, we exploit within-auction differences in log bids, which differences out the common auction-level cost component exactly. Specifically, the within-auction difference is

$$\Delta_i = \log b_{r(i)} - \log b_i = \log \beta(w_{r(i)}) - \log \beta(w_i), \tag{5}$$

which is purged off the common auction effect. Here $r(i)$ denotes i's rival. The first-order condition (2) can then be expressed as

$$\frac{b_i - c_i}{b_i} = m(u_i) = \frac{1 - F_\Delta(0 \mid u_i)}{f_\Delta(0 \mid u_i)}, \tag{6}$$

where $u_i = \log b_i - \gamma x = \log \beta(w_i)$ denotes the residualized log bid. F_Δ denotes the residualized log bid distribution and f_Δ is the corresponding density. Details on the derivation are provided in Appendix Section A.1.

Equation (6) shows that equilibrium markups depend only on the conditional distribution of within-auction bid differences evaluated at zero. Auction-level heterogeneity enters only through the conditioning variable (u_i), which governs how markups vary across auctions, while it is eliminated entirely from the bid differences themselves. Consequently, residualizing observed bids is required only to construct (u_i); estimation of the bid-difference distribution is unaffected by common auction-level cost shocks.

Our object of interest is the mean markup by bidder, an expectation of the per-bid ratio (6) over bidder v's bids,

$$\bar{m}_v = \mathbb{E}[\, m(u) \mid v \,] = \mathbb{E}\left[\frac{1 - F_\Delta(0 \mid u)}{f_\Delta(0 \mid u)} \,\middle|\, v \right], \qquad v \in \{A, B\}. \tag{7}$$

As discussed earlier, auction level heterogeneity only enters the average markup through u, the residualized bids. In the application below as well as in complementary simulations, we find however that correctly accounting for heterogeneity in markups in construction and integration has only relatively small effects for the average markup.[3]

Results. We estimate the mean markup in two steps. First, we residualize the log bids by regressing them on observed item characteristics x and taking the residuals $\hat{u}_i = \log b_i - \hat{\gamma} x_i$. Second, we apply a flexible Kernel estimator, see Appendix Section A.2 for details. Table 2 reports the estimated average markups $\hat{\bar{m}}_v$ by vendor and overall. The first row presents results for our baseline Kernel estimator. For the dominant vendor we estimate an average markup of 23% over marginal costs and for the smaller vendor, that has a cost disadvantage on average, an average markup of 11%. On average we estimate a markup of 17%. The estimates are robust to alternative bandwidth choices (scaling the baseline parameter up and down by a factor of 10; second and third rows) and to a more parsimonious residualization of log bids that controls only for pounds per case (last row).

Discussion. These estimates should be interpreted with caution, as they are based on procurement data from a single school district and may therefore not generalize to other

[3] For instance, a naiive estimator

$$m_v^{\text{unc}} = \frac{\mathbb{E}[1 - F_\Delta(0 \mid u) \mid v]}{\mathbb{E}_u[\, f_\Delta(0 \mid u) \mid v \,]}.$$

Table 2: Mean proportional markup by bidder:

Estimator	Vendor A	Vendor B	Average
Vendor-stratified kernel (baseline)	23%	11%	17%
larger bandwidth, $10\,h_u$	21%	9%	15%
smaller bandwidth, $h_u/10$	24%	7%	15%
pounds-only residualization	23%	11%	17%

Notes: The table presents estimated average markups of bids over marginal costs following equation (7). The data come from 58 contested two-bidder first price auctions held by one school food authority. We present estimated markups for each bidder (A and B) as well as the pooled average over bidders and items in the last column. The first row present baseline estimates based on the estimator outlined in equation (A3). Rows two and three presents results on alternative bandwidth parameters that scale the baseline choice, h_u, by a factor of 10. The last row reports estimates using log bids per pound as residualized bids, without removing food-cluster fixed effects.

districts. We chose this setting because contracts were awarded through item-by-item first-price procurement auctions and the underlying bid data were available in a sufficiently detailed and tractable format to recover markups.

Despite this limitation, the estimates suggest economically meaningful market power. The average estimated markup is 17%, which is substantial because it applies to the entire procurement cost—including the manufacturer's price—not just distribution services.

The estimates also highlight the potential importance of competition. Returning to equation (2), the equilibrium markup is inversely proportional to both the elasticity of winning, which in turn depends on the number of competitors. Under the symmetric benchmark, increasing the number of bidders from two to $N = 3$ reduces the markup by a factor of $\frac{N-1}{N}$, implying a 50% reduction. Applied to our estimate, the average markup could decline from 17% to approximately 8.5%. While this calculation is illustrative and abstracts from bidder asymmetries and endogenous entry, it suggests that differences in the number of effective bidders may account for economically important cross-district differences in procurement prices.

5 Rockets and Feathers: Intertemporal Changes in Markups

While the recovered markups at contract award are already substantial, they may increase further over the life of the contract. Many school food procurement contracts are multi-year agreements with annual price adjustment provisions. If vendors have private information about their marginal cost shocks, they may be able to pass through cost *increases* while retaining the gains from cost *decreases*. As a result, contracted prices can drift progressively further above marginal costs over the life of the contract, creating a "rockets and feathers" dynamic on top of an already supra-competitive award price [Remer, 2015].

To quantify this mechanism, we measure how markups evolve over the life of a contract by comparing changes in contracted prices with two proxies for cost inflation. Conceptually, we define the change in the log markup for item i as the log change in its contracted price minus the log change in costs in contract year t:

$$\Delta\mu_{it} = log(p_{it}) - log(p_{it-1}) - (log(c_{it}) - log(c_{it-1})). \tag{8}$$

We investigate markup dynamics using three multi-year renewal contracts from two school food authorities in the Los Angeles MSA, all awarded to one of the vendors analyzed above. At contract award, annual price adjustments were negotiated using the one-year

change in the Los Angeles Consumer Price Index (CPI), excluding housing and shelter, as a benchmark for input cost inflation.[4] We therefore use annual CPI inflation as a first proxy for the average cost growth, averaged across all items provided by the specific distributor:

$$\Delta \text{CPI}_t \approx \frac{1}{I} \sum_{i=1}^{I} \left(\log c_{it} - \log c_{i,t-1} \right). \tag{9}$$

Figure 5 illustrates how the change in the CPI compares with price changes for 672 items from one example contract renewal. The annual increase in the Los Angeles CPI (excluding housing and shelter) was 2.88% for the specific renewal period, shown by the vertical line. The histogram reports the realized item-level contract price changes,

$$\log(p_{it}) - \log(p_{i,t-1}), \tag{10}$$

between contract years (t-1) and (t). Two features stand out. First, there is substantial bunching at the CPI benchmark. Second, there is very little mass to the left of the benchmark, whereas many items experience price increases above the CPI.

This pattern suggests that the CPI serves as a floor rather than a benchmark for annual price adjustments. Our interpretation is that vendors pass through cost increases that exceed the CPI benchmark, but do not symmetrically pass through cost decreases when realized cost inflation falls below the benchmark. Consequently, contract prices ratchet upward over time, generating a "rockets and feathers" pattern in contract renewals and increasing markups over the life of the contract.[5]

We test this prediction using a second, independent proxy for cost shocks. Each year, USDA updates the value of commodity contributions provided to manufacturers participating in the National School Lunch Program. Food ingredient formulas specify the pounds of USDA commodities used in each processed product. Combining these formulas with annual USDA commodity values allows us to quantify commodity input costs for each item. Because commodity values change from year to year and formulas differ across products, this generates plausibly exogenous item-level variation in production costs. We express the commodity contribution as a share of each item's baseline contract price and interpret changes in this measure as proportional cost shocks.[6]

Figure 6 relates the approximated percent changes in costs to realized contract price changes at renewal. The horizontal axis reports the change in the USDA commodity contribution (cost proxy), relative to the baseline price. We show cost changes minus CPI

[4]For instance, the language in the initial contract states 'Minimum contract term is one (1) year. Quoted prices must stay in effect for one (1) year beginning on []. This contract may be extended (by mutual consent expressed in writing) for up to four (4) additional one (1) year increments []. The extension may be granted on a year-by-year basis provided that the District has deemed the products and services of the vendor satisfactory. Agreement prices that are subject to increase for each period shall be base on a percentage increase in the annual Consumer Price Index (C.P.I.) for all urban consumers for the Los Angeles Area'.

[5]Consistent with that, the language in the contract renewal states: '[] respectfully requests a one-year extension effective [] with the following representation: 1. Manufacturer price changes: Supporting documentation will be provided to the district upon request. 2. CPI Increase: 2.88% Based on the Consumer Price Index for Los Angeles-Long Beach-Anaheim, CA "All Urban Consumers" "All Items Less Shelter".

[6]Our analysis considers commercial prices which are not affected by discounts provided through pass-through values as part of USDA entitlements.

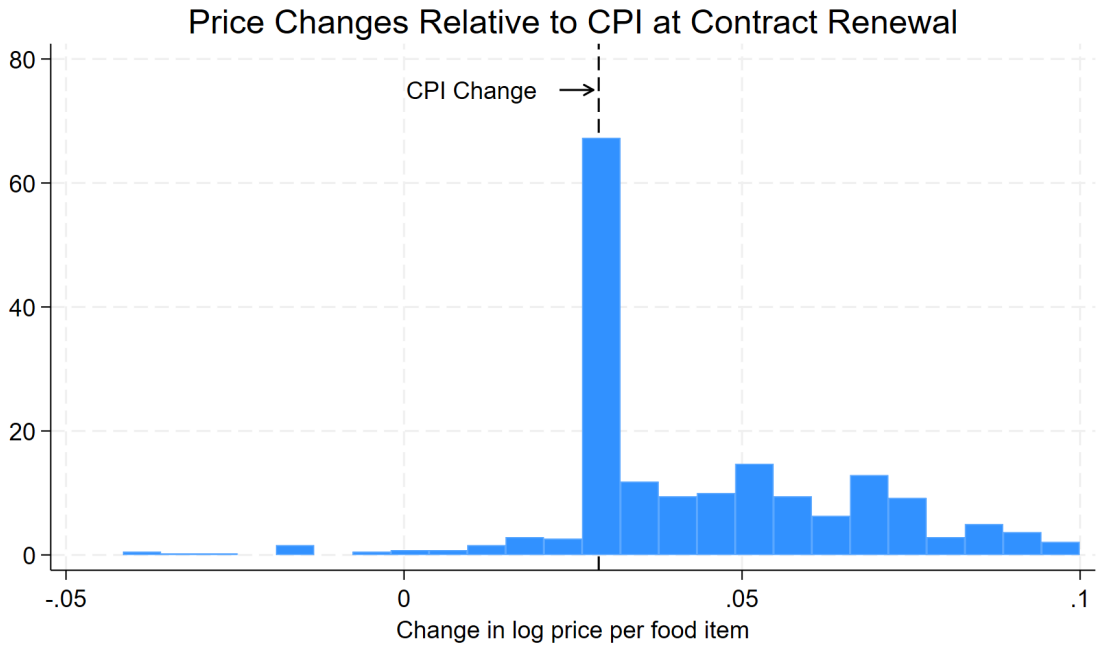


Figure 5: Bunching of price increases at renewal

Notes: The histogram summarizes the distribution of log changes in prices per case, $\log(p_{it}) - \log(p_{i,t-1})$, at contract renewal for school year t. The data come from a single contract renewal (from school year 23/24 to school year 24/25) for one school food authority located in the Los Angeles–Long Beach–Anaheim MSA. The vertical line denotes the annual change in the CPI (less-shelter) for the broader Los Angeles MSA at +2.88%. The CPI change is the stated benchmark for price changes at contract renewal.

inflation. A value of zero corresponds to a cost change equal to CPI inflation. The vertical axis reports the realized percent change in prices.

$$\log(p_{it}) - \log(p_{i,t-1}). \tag{11}$$

The estimated relationship is strongly asymmetric. For items experiencing relative cost increases above the CPI benchmark, contract prices rise approximately one-for-one with costs, as reflected by the upward-sloping relationship to the right of zero. In contrast, costs growing at a lower rate, growing less than the CPI change, exhibit little corresponding reductions in contract price growth. Instead, prices continue to increase by about 5% throughout.[7] This asymmetric pass-through is precisely the "rockets and feathers" pattern predicted by the renewal model and implies that markups increase over the life of the contract.

Within our framework, these estimates imply that vendors are able to preserve their initial markups on products whose costs increase faster than the CPI benchmark, as higher costs are largely passed through into contract prices. In contrast, for products whose costs grow more slowly than the CPI (decline relative to the benchmark) contract prices continue to rise by approximately the CPI adjustment. As a result, markups increase over the life of the contract. We also note that one of the school food authorities in this analysis is a large purchasing cooperative, suggesting that scale alone is insufficient to prevent markup growth.

[7]This still exceeds the CPI inflation benchmark, likely reflecting other cost shocks not captured by our proxy.

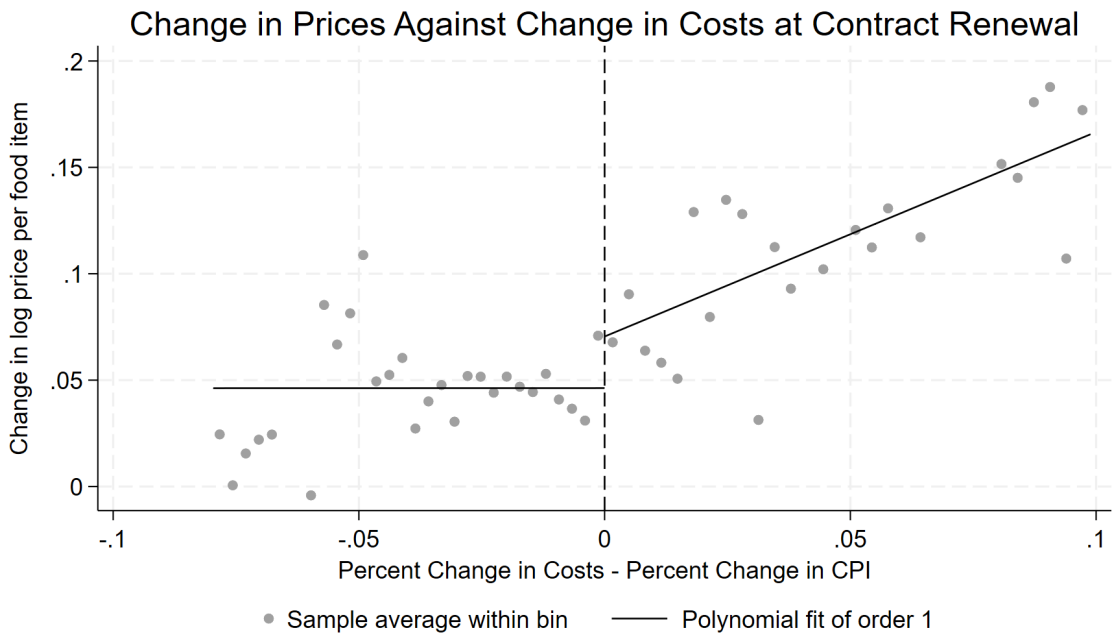


Figure 6: Asymmetric pass-through of costs at contract renewal

Notes: The bin scatter plot relates changes in log prices against percent changes in costs at contract renewal for school year t. The data come from one three contract renewals for two school food authorities located in the Los Angeles–Long Beach–Anaheim MSA. The vertical axis denotes log changes in prices per case, $\log(p_{it}) - \log(p_{i,t-1})$. The horizontal axis denotes approximated percent changes in costs $\frac{c_{it}-c_{it-1}}{p_{it-1}}$, see the text for more details, minus the percent change in the CPI (less-shelter) for the broader Los Angeles MSA. The CPI change is the stated benchmark for price changes at contract renewal. The vertical line delineates relative changes in costs that fall below or above the CPI change. The solid lines show separate linear fits for observations with cost changes below and above the CPI benchmark.

The implied increases can be economically meaningful. For example, a product whose costs decline by 5 percentage points relative to the CPI benchmark experiences little corresponding reduction in its contract price, implying an increase in the markup of roughly 5 percentage points. Because these asymmetric price adjustments occur at each contract renewal, the effect compounds over time, causing markups to drift upward over the life of long-term contracts.

More broadly, the results suggest that contract renewals constitute an additional source of markup dispersion across school districts. Districts with older contracts or more renewal cycles may face systematically higher markups than districts that have recently rebid their contracts, contributing to the substantial cross-district variation in procurement prices documented earlier.

6 Conclusion and Next Steps

This paper studies an important but largely unexplored component of public service delivery: how efficiently local governments procure food for school meal programs. Using a newly assembled database covering more than 100 California school districts and over $1 billion in procurement spending, we document substantial price dispersion for identical manufacturer-specified products. The descriptive evidence shows that these differences cannot be fully explained by transportation costs or product heterogeneity and instead

point toward procurement practices, distributor choice, and supplier market power as important determinants of procurement costs.

To quantify these mechanisms, we develop two complementary empirical approaches. The first recovers supplier markups from competitive procurement auctions using equilibrium bidding conditions from first-price procurement auctions. The second measures the evolution of markups over the life of multi-year contracts by exploiting variation in contract renewals and input-cost shocks. Preliminary evidence from both approaches suggests economically meaningful markups and highlights how procurement design may substantially affect the cost of delivering school meal programs.

The current paper represents an advanced early stage of a broader research agenda. The underlying procurement records have largely been collected, but a substantial share of historical bid tabulations, contract amendments, and invoice records are still being digitized and harmonized. The principal objective over the coming months is therefore to expand the structural analyses to the full database. This will allow us to estimate markups across a broader set of school districts, purchasing cooperatives, vendors, products, and procurement environments, and to examine heterogeneity by market structure, purchasing scale, procurement method, and distributor.

Finally, we will use the completed database to evaluate the potential savings associated with alternative procurement strategies, including expanded competition, direct purchasing from manufacturers where feasible, purchasing cooperatives, and alternative contract designs. By quantifying how procurement institutions affect the cost of delivering school meals, the completed paper aims to provide practical guidance for school districts seeking to improve the efficiency of a major public program while maintaining nutrition standards and service quality.

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A Appendix

A.1 Logs and the Conditional Difference Identity

Work with log bids $\beta = \log b$, and let $\widetilde{G}, \widetilde{g}$ be the c.d.f. and density of the log bid. The change of variables gives $\widetilde{G}(\beta) = G(b)$ and $\widetilde{g}(\beta) = g(b)\, b$, so the b in the denominator of (2) cancels:

$$\frac{b-c}{b} = \frac{1-G(b)}{b\, g(b)} = \frac{1-\widetilde{G}(\beta)}{\widetilde{g}(\beta)}. \tag{A1}$$

The proportional markup is the inverse hazard of the log–bid distribution at the own log bid—scale–free, which is what makes pooling across heterogeneous items sensible.

Now define the rival–minus–own log–bid difference $\Delta = \beta_r - \beta_i$. With independent private values $\beta_r \sim \widetilde{G}$ is independent of β_i; conditioning on the own log bid $\beta_i = \beta$, $\Delta \mid \beta = \beta_r - \beta$ is a shifted copy of the rival log bid, so

$$F_\Delta(0 \mid \beta) = \widetilde{G}(\beta), \qquad f_\Delta(0 \mid \beta) = \widetilde{g}(\beta). \tag{A2}$$

Combining (A2) with (A1) gives the central identity.

Proposition 1 (Markup as a conditional inverse hazard) *For every own log bid β,*

$$m(\beta) \;\equiv\; \frac{b-c}{b} \;=\; \frac{1-\widetilde{G}(\beta)}{\widetilde{g}(\beta)} \;=\; \frac{1-F_\Delta(0 \mid \beta)}{f_\Delta(0 \mid \beta)}. \tag{A3}$$

Interpretation. $1 - F_\Delta(0 \mid \beta) = \Pr(\text{own wins} \mid \beta)$ is the conditional win probability and $f_\Delta(0 \mid \beta)$ the conditional density of ties, so $m(\beta) =$ (win probability)/(tie density). (Sign convention: with rival$-$own, winning is $\Delta > 0$ and the numerator is $1 - F_\Delta(0 \mid \beta)$; defining the difference own$-$rival flips it to $F_\Delta(0 \mid \beta)$—the same number.)

A.2 Estimation Details

We estimate the mean markup in two steps. First, we residualize the log bids by regressing them on observed item characteristics x and taking the residuals $\hat{u}_i = \log b_i - \hat{\gamma} x_i$. Second, we apply a flexible Kernel estimator:

$$\hat{\bar{m}}_v = \frac{1}{n_v} \sum_{i:\, v(i)=v} \hat{m}(\hat{u}_i) = \frac{1}{n_v} \sum_{i:\, v(i)=v} \frac{\sum_j w_{ij}(\hat{u}_i, \hat{u}_j)\, \mathbf{1}\{\Delta_j > 0\}}{\sum_j w_{ij}(\hat{u}_i, \hat{u}_j)\, K(\Delta_j / h_\Delta)/h_\Delta}, \tag{A4}$$

where K is a Gaussian Kernal with and h a (Silverman) bandwidth. Intuitvely, the bandwidth is chosen in a way to match the mass of of density of differences in log bids in Figure 4. To construct the conditional markups, we weight neighboring observations using a separate Gaussian Kernel. The weights are given by

$$w_{ij}(\hat{u}_i, \hat{u}_j) = K\Big(\frac{\hat{u}_j - \hat{u}_i}{h_u}\Big)\, \mathbf{1}\{v(j) = v(i)\}. \tag{A5}$$

The bandwidth parameter h_u determines how auction level heterogeneity, here governed by the residualized bids, enters the average markup estimate. For instance, a very large bandwidth parameter assigns all auctions into effectively one bin effectively abstracting from auction level heterogeneity. Conversely, a small bandwidth parameter treats every auction separately, placing a lot of weight on auction level heterogeneity. In our baseline, we set h_u by the same Silverman normal-reference rule used for h_Δ, now applied to the residualized bids: $h_u = 0.9\, \min(\hat{\sigma}_u, \mathrm{IQR}_u/1.349)\, n^{-1/5}$.